



# A Practitioner's Perspective on Taxonomy, Ontology and Findability



NASA Johnson Space Center

**Sarah Berndt**  
**JSC Taxonomist**  
**DB Consulting**

**Information Technology and Multimedia Services Contract**  
**May, 2011**



# Case Study: Semantic System

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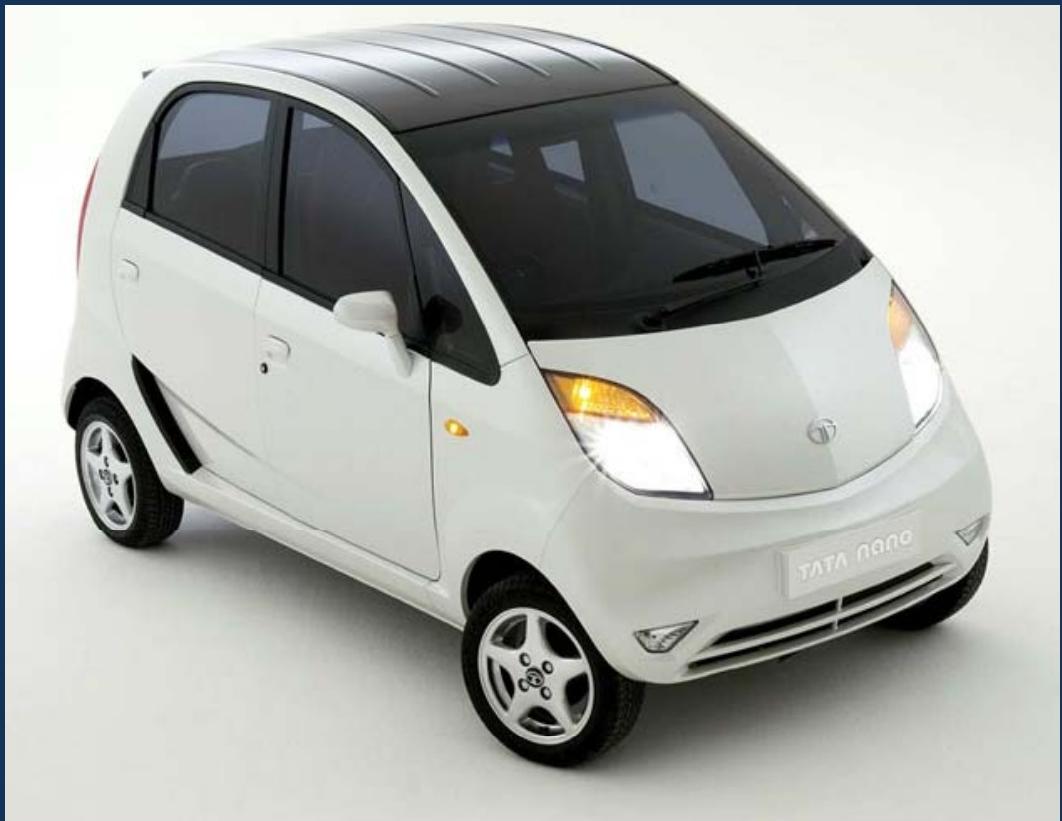
- This case study follows the NASA “Case of Interest” definition, meaning it illustrates the value of best practices that might otherwise seem insignificant, in order to promote effective implementation.
  
- Product Endorsement Disclaimer  
This is not product endorsement but a case study on what we have done and suggestions for the recognition and development of a semantic system.



# Demonstrated Need

- Need for broad categories of information that easily map to/integrate with existing information architecture
- Need for evolving procedures and processes that are easily maintained and fit users needs
- Internal & External analysis
  - Subject Matter Expert (SME) interviews
  - Repository owners, content creators
  - NASA Thesaurus
  - Dow Jones Taxonomy Services
  - Taxonomy consultants

# Functional



<http://www.autoblog.com/media/2009/09/tata-nano-lux-white-630.jpg>



[www.tatapeopescar.com](http://www.tatapeopescar.com)

JSC needed an uncomplicated, functional system to improve information accessibility and retrieval.

# Succinct Planning = Successful Implementation

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The vision for the JSC Taxonomy is to create a controlled vocabulary to connect information stovepipes into an integrated view.

The envisioned end results are:

- Increased information accessibility, relevancy and currency
- Improvement of the information consumers' user experiences

The scope of the JSC Taxonomy is:

- To encompass JSC created and/or owned content
- To include local level vocabularies, not to replace existing information architecture



# Monetized Need

## ➤ Cost Benefit Analysis

- Evidence-based measurement of JSC information workers' search habits, contrasted with industry standards and considering the current search environment/available applications
- Information worker = content owners and creators, information consumers
- Conservative, salary based value only. Additional costs such as benefits and multiple employee efforts not included.
  - 8.8 hrs/wk average information worker\*
  - 10.5 hrs/wk average JSC information worker  
\$21,840 annual cost per employee

\* International Data Corporation Hidden Costs of Information Work: A Progress Report, May 2009,  
Doc # 217936

# Investment that Pays



<http://www.jaguarxf.info/>

The advantages of planning  
and technology.



# Semantic Systems as Tools



# System Review



- International Standards Organization, ISO 2788  
(establishment of a monolingual thesauri)  
to 25964- parts I-IV (thesauri & interoperability with other vocabularies).
- Dublin Core Metadata schemas and vocabulary type
- Z39.50- semantic protocol for search and retrieval from remote computer databases.



# The Advantages of Planning and Technology

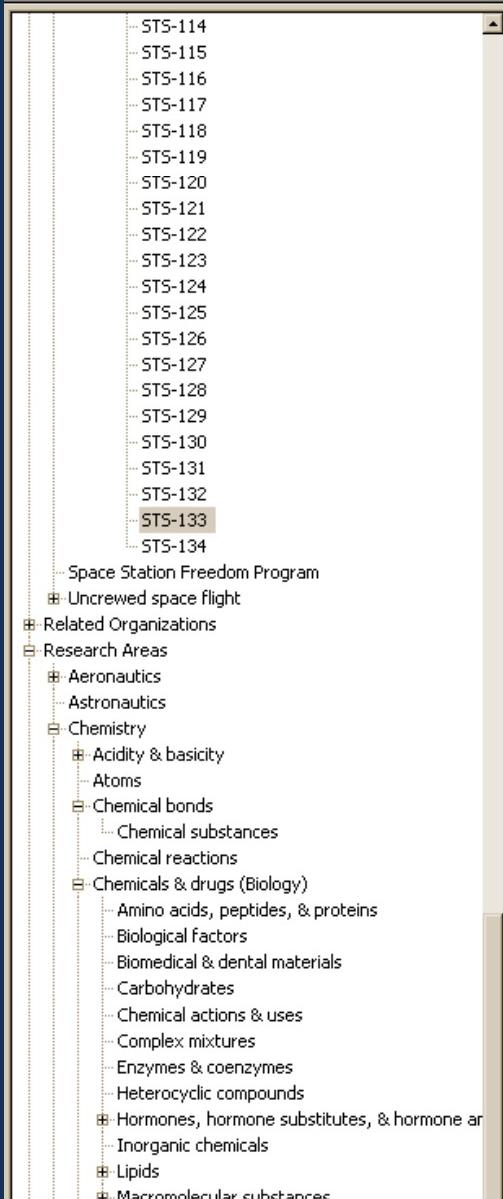


Space Shuttle Discovery, STS-133, on its final ascent, February 24, 2011

- Speeds of over 17,000 mph in ~ 8 minutes = acceleration of 2,000 mph each minute
- Two solid rocket boosters
- Three Space Shuttle Main Engines (SSMEs)
- Two Orbital Maneuvering System (OMS) engines to place the vehicle in orbit
- 38 primary and six vernier Reaction Control System engines for separation and in-space propulsion



# Components of the Semantic System



- Controlled Vocabulary
  - Hierarchy
  - Preferred terms
- Ontology
- Equivalence Relationships
  - NonPreferred Terms

Type	Term
BT	Space Shuttle crewed missions

Associative	
Type	Term
Car...	Multi-purpose logistics modules
Car...	Permanent Multi-Purpose Module
Car...	Robonaut 2
Cre...	Barratt, Michael R.
Cre...	Boe, Eric
Cre...	Bowen, Stephen G.
Cre...	Drew, B. Alvin
Cre...	Lindsey, Steven W.
Cre...	Stott, Nicole P.
Has...	Discovery
Lau...	Launch Pad 39A

Equivalence	
Type	Term
UF	Shuttle 133
UF	Space Shuttle 133
UF	STS 133

# Components of the Semantic System (2)



## Preferred terms to generate rulebases

	STS-113_791_Missions.xml	XML Docum...	3/10/2011 11:27 AM
	STS-114_792_Missions.xml	XML Docum...	3/10/2011 11:27 AM
	STS-115_793_Missions.xml	XML Docum...	3/10/2011 11:27 AM
	STS-116_794_Missions.xml	XML Docum...	3/10/2011 11:28 AM
	STS-117_795_Missions.xml	XML Docum...	3/10/2011 11:27 AM
	STS-118_796_Missions.xml	XML Docum...	3/10/2011 11:28 AM
	STS-119_797_Missions.xml	XML Docum...	3/10/2011 11:28 AM
	STS-120_798_Missions.xml	XML Docum...	3/10/2011 11:26 AM
	STS-121_799_Missions.xml	XML Docum...	3/10/2011 11:28 AM
	STS-122_800_Missions.xml	XML Docum...	3/10/2011 11:26 AM
	STS-123_801_Missions.xml	XML Docum...	3/10/2011 11:26 AM
	STS-124_802_Missions.xml	XML Docum...	3/10/2011 11:27 AM
	STS-125_2541_Missions.xml	XML Docum...	3/10/2011 11:27 AM
	STS-126_803_Missions.xml	XML Docum...	3/10/2011 11:26 AM
	STS-127_23321_Missions.xml	XML Docum...	3/10/2011 11:27 AM
	STS-128_23611_Missions.xml	XML Docum...	3/10/2011 11:26 AM
	STS-129_23613_Missions.xml	XML Docum...	3/10/2011 11:27 AM
	STS-130_23618_Missions.xml	XML Docum...	3/10/2011 11:27 AM
	STS-131_23620_Missions.xml	XML Docum...	3/10/2011 11:26 AM
	STS-132_31919_Missions.xml	XML Docum...	3/10/2011 11:28 AM
	STS-133_31921_Missions.xml	XML Docum...	3/10/2011 11:26 AM
	STS-134_31923_Missions.xml	XML Docum...	3/10/2011 11:27 AM
	Structure & Function Related Neuronal Plasticity_52631_Equipment.xml	XML Docum...	3/10/2011 11:36 AM
	Structure & Solidification of Largely Undercooled Melts_61253_Equipment.xml	XML Docum...	3/10/2011 11:36 AM
	Student Temporary Employment Program_57111_Functions.xml	XML Docum...	3/10/2011 11:23 AM
	Studies of Ionization States_47768_Equipment.xml	XML Docum...	3/10/2011 11:36 AM
	Studio photography_32941_Functions.xml	XML Docum...	3/10/2011 11:23 AM
	Study Capillary Waves on Water Surface_47502_Equipment.xml	XML Docum...	3/10/2011 11:36 AM
	Study of Meteoroid Impact Craters on Various Materials_49555_Equipment.xml	XML Docum...	3/10/2011 11:36 AM
	Study of the Effects of Mammalian Gravity Receptors_50175_Equipment.xml	XML Docum...	3/10/2011 11:36 AM
	Study Proposed Propellant Acquisition System_47494_Equipment.xml	XML Docum...	3/10/2011 11:36 AM
	Study Solar Flux Separation_47500_Equipment.xml	XML Docum...	3/10/2011 11:36 AM



# Components of the Semantic System (3)

Rulebases are informed by the taxonomy and ontology, the proximity and location of terms, and different weights to enhance the accuracy of Classification.

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<!-- TITLE RULES FOR NPTs -->
- <combine weight="100" label="link.Missions.STS-133.31921_TITLE_NPT" _key="k815323">
  <!-- multi-word NPT - title -->
  - <max not="0" scale="0" weight="100" _key="k815325">
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  </max>
  - <max not="0" scale="0" weight="100" _key="k815344">
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      </any>
      <text case="0" field="title" weight="100" not="0" data="Shuttle" stem="1" _key="k815348" />
      <text case="0" field="title" weight="100" not="0" data="133" stem="1" _key="k815349" />
    </phrase>
```

# Classification Driven Results



Subset of the content corpus

Fewer, more relevant results

Basic Search | Advanced Search | NASA Search | JSC Home | FAQ | A-Z | New Features | Ask A Librarian | Submit Feedback

inside JSC Johnson Space Center Search JSC Results 1 - 10 of about 1470 for STS-133 (0.11 seconds) Sort by date

**Search**

**Beta Features and Feedback**

Limited By ?

STS-133 [Update] [Clear All]

**Limit To ?**

Show Full Tree

**Content**

- Document
- PDF
- PowerPoint
- Spreadsheet
- Web Page
- XML

Show all file types

**Facilities & Labs**

- Launch Pad 39A

**Functional Areas**

- Safety
- Johnson Space Center Administration
- Alerts
- Coordination
- Evaluation

**People**

- Anderson, Michael P.

**Programs & Missions**

- STS-107
- Space Shuttle crewed missions
- On orbit
- STS-130
- STS-133**
- STS-134

**Systems & Equipment**

- Discover
- Endeavour
- International Space Station
- Extravehicular Mobility Unit
- Crew Compartment
- Certification
- Space Shuttle

**STS-133**

Programs & Missions » Space Shuttle Program » Space Shuttle missions » Space Shuttle crewed missions » **STS-133** » Discovery's STS-133 flight will deliver install the Permanent Multipurpose Module, the Express Logistics Carrier 4 and provide critical spare components to the International Space Station. This will be the 39th shuttle mission to the station, and Discovery's last flight.

Related Information [show]

**Kennedy Media Gallery** [Relevance Score: 10 of 10] ⓘ  
... Category: STS-133, To refine search, enter text here + GO. Open Image KSC-2011-1327, KSC-2011-1327 (02/01/2011) --- CAPE CANAVERAL, Fla. ... mediarchive.ksc.nasa.gov/search.cfm?cat=214 - 68k - Request Removal

Home - **STS-133/ULF5 JOP** [Relevance Score: 10 of 10] ⓘ  
... STS-133/ULF5 JOP. This Site, Go Search. ... DA8/Flight Director Office > STS-133/ULF5 JOP. STS-133/ULF5 JOP. Shuttle FD ... modspops.jsc.nasa.gov/mod/DA8/JOP\_ulf5\_sts133/default.aspx - 123k - 2011-02-09 - Request Removal

**Image Science & Analysis Group (STS-133)** [Relevance Score: 10 of 10] ⓘ  
... STS-133 Mission Information The link to the old web site is generated here. ... Mission Information. Mission: STS-133. Pad: A. Launch: 134. MLP: ... isag.jsc.nasa.gov/shuttle>ShowPage.pl?template=mission.htm&mission=STS-133 - 18k - Request Removal

Home - **STS-133/ULF5 JOP** [Relevance Score: 10 of 10] ⓘ  
... STS-133/ULF5 JOP. This Site, Go Search. ... DA8/Flight Director Office > STS-133/ULF5 JOP. STS-133/ULF5 JOP. Shuttle FD ... modspops.jsc.nasa.gov/mod/DA8/JOP\_ulf5\_sts133/ - 123k - 2011-02-09 - Request Removal

**Image Science & Analysis Group (ULF5/STS-133)** [Relevance Score: 10 of 10] ⓘ  
... ULF5/STS-133 Mission Information The link to the old web site is generated here. ... Mission Information. Mission: ULF5/STS-133. Vehicle: Discovery. ... isag.jsc.nasa.gov/Station>ShowPage.pl?template=mission.htm&mission=ULF5/STS-133 - 16k - Request Removal

**STS 133/ULF5 Document Library** [Relevance Score: 10 of 10] ⓘ  
... STS-133/ULF5 JOP. This Site, Go Search. ... JOP > STS-133/ULF5 Document Library. ... modspops.jsc.nasa.gov/mod/DA8/JOP\_ulf5\_sts133/STS133ULF5%20Document%20Library/Forms/AllItems.aspx - 76k - 2011-02-09 - Request Removal

Home - **STS-133/ULF5 JOP** [Relevance Score: 10 of 10] ⓘ  
... STS-133/ULF5 JOP. This Site, Go Search. ... DA8/Flight Director Office > STS-133/ULF5 JOP. STS-133/ULF5 JOP. Shuttle FD ... modspops.jsc.nasa.gov/mod/DA8/JOP\_ulf5\_sts133/ - 123k - 2011-02-09 - Request Removal

**Image Science & Analysis Group (STS-133)** [Relevance Score: 10 of 10] ⓘ  
... STS-133 Mission Information The link to the old web site is generated here. ... Mission Information. Mission: STS-133. Pad: A. Launch: 134. MLP: ... isal-web1.jsc.nasa.gov/shuttle>ShowPage.pl?template=mission.htm&mission=STS-133 - 18k - Request Removal

[MS WORD] **NASA Letterhead with "Meatball"** [Relevance Score: 10 of 10] ⓘ  
... TO: Distribution. FROM: DA8/STS-133 Lead Flight Director. ... SUBJECT: STS-133/ULF-5 Joint Operations Panel #2 Minutes. ...



# Components of the Semantic System (4)

- Term metadata library
- Mapping to the interface
- Standards for inclusion

STS-133

Class: SpaceShuttleProgram

Term Information

image_title:	Image of the STS-133 mission patch
image_URL:	<a href="https://io.jsc.nasa.gov/photos/10413/thum/sts133-s-001.jpg">https://io.jsc.nasa.gov/photos/10413/thum/sts133-s-001.jpg</a>
site_description:	Discovery's STS-133 flight will deliver and install the Permanent Multipurpose Module, the Express Logistics Carrier 4, and provide critical spare components to the International Space Station. This was the 35th shuttle mission to the station, and Discovery's last flight.
site_title:	STS-133
site_URL:	<a href="http://www.nasa.gov/mission_pages/shuttle/shuttlemissions/sts133/index.html">http://www.nasa.gov/mission_pages/shuttle/shuttlemissions/sts133/index.html</a>

# Term Information Driven Interface



Basic Search | Advanced Search | NASA Search | JSC Home | FAQ | A-Z | New Features | Ask A Librarian | Submit Feedback

inside JSC Johnson Space Center Search JSC Results 1 - 10 of about 1470 for STS-133 (0.11 seconds) Sort by date

**Search**

**Beta Features and Feedback**

**Limited By** [?](#)

STS-133 [\[Update\]](#) [\[Clear All\]](#)

**Limit To** [?](#)

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- On orbit
- STS-130
- STS-133**
- STS-134

**Systems &**

- Discovery
- Endeavour
- International Space Station

**STS-133**

Discovery's STS-133 flight will deliver install the Permanent Multipurpose Module, the Express Logistics Carrier 4 and provide critical spare components to the International Space Station. This will be the 35th shuttle mission to the station, and Discovery's last flight.

**Related Information** [?](#) [\(hide\)](#)

Carried	Crewed by	Has vehicle	Launched from
Multi-purpose logistics modules Robonaut 2	Barratt, Michael R. Boe, Eric Drew, B. Alvin Kopra, Timothy L. Lindsey, Steven W. Stott, Nicole P.	Discovery	Launch Pad 39A

**Kennedy Media Gallery** [Relevance Score: 10 of 10] [\(?\)](#)  
... Category: STS-133. To refine search, enter text here + GO. Open Image  
KSC-2011-1327. KSC-2011-1327 (02/01/2011) --- CAPE CANAVERAL, Fla. ...  
[mediaarchive.ksc.nasa.gov/search.cfm?cat=214 - 66k](#) - [Request Removal](#)

**Home - STS-133/ULF5 JOP** [Relevance Score: 10 of 10] [\(?\)](#)  
... STS-133/ULF5 JOP. This Site, Go Search. ... DA8/Flight Director Office >  
STS-133/ULF5 JOP. STS-133/ULF5 JOP. Shuttle FD ...  
[modpops.jsc.nasa.gov/mod/DA8/JOP\\_ulf5\\_sts133/default.aspx - 123k](#) - [2011-02-09](#) - [Request Removal](#)

**Image Science & Analysis Group (STS-133)** [Relevance Score: 10 of 10] [\(?\)](#)  
... STS-133 Mission Information The link to the old web site is generated here. ...  
Mission Information. Mission: STS-133, Pad: A. Launch: 134, MLP: ...  
[isag.jsc.nasa.gov/shuttle>ShowPage.pl?template=mission.htm&mission=STS-133 - 18k](#) - [Request Removal](#)

**Home - STS-133/ULF5 JOP** [Relevance Score: 10 of 10] [\(?\)](#)  
... STS-133/ULF5 JOP. This Site, Go Search. ... DA8/Flight Director Office >  
P. STS-133/ULF5 JOP. Shuttle FD ...  
[a.gov/mod/DA8/JOP\\_ulf5\\_sts133/ - 123k](#) - [2011-02-09](#) - [Request Removal](#)

**& Analysis Group (ULF5/STS-133)** [Relevance Score: 10 of 10] [\(?\)](#)  
Mission Information The link to the old web site is generated  
formation. Mission: ULF5/STS-133, Vehicle: Discovery. ...  
[Station>ShowPage.pl?template=mission.htm&mission=ULF5/STS-133 - 16k](#) - [Request Removal](#)

**Document Library** [Relevance Score: 10 of 10] [\(?\)](#)  
JOP. This Site, Go Search. ... JOP > STS-133/ULF5

Document Library. STS-133/ULF5 Document Library. ...

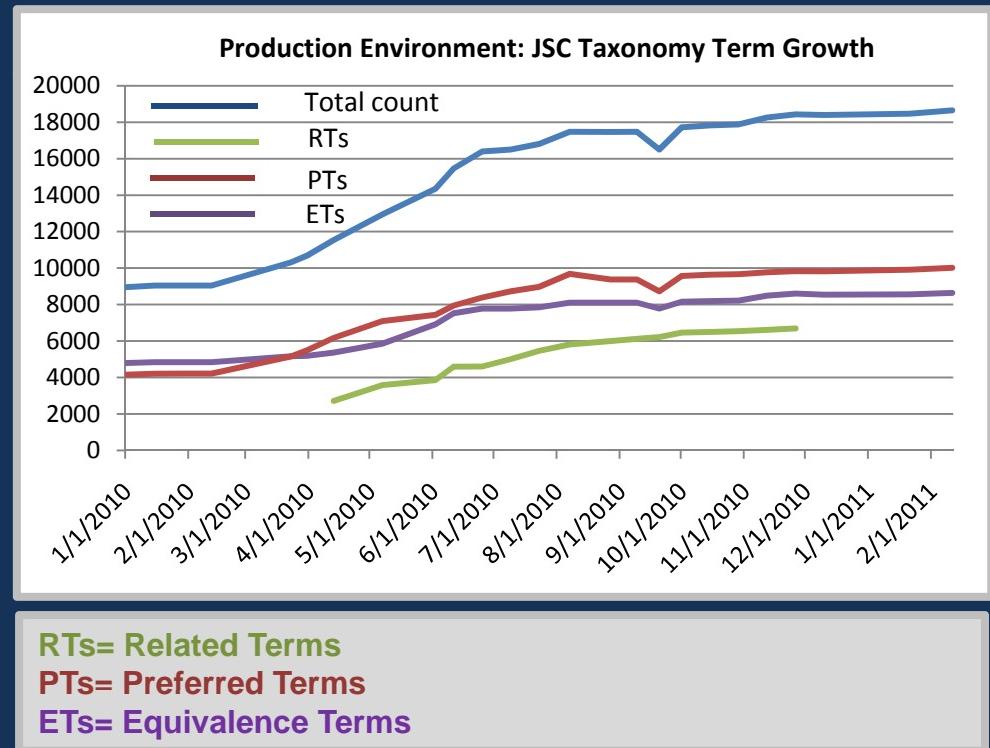


# Evolution of the Semantic System

Since January 2010, the JSC Taxonomy has more than doubled in term count while the scope of areas covered has grown exponentially!

Seven 'Top Level' facets are active in the JSC Google Search.

- Within the facets are over 100 'Classes' (major categorizations), many of which are taxonomies in their own right.
- Within the classes are over 8,000 preferred terms with nearly 17,000 relationships between them. These relationships make up the JSC Ontology!
- Best bet URLs, images and definitions have been added to further enrich results in the Google Search Appliance





# Encourage User Participation

A	B	C	D	E	F	G	H	I	J	K	L	M	
Preferred Term										Level	Scope Notes	Comments	
				STS-126						(level 4)			
				STS-127						(level 4)			
				STS-128						(level 4)			
				STS-129						(level 4)			
				STS-130						(level 4)			
				STS-131						(level 4)			
				STS-132						(level 4)			
				STS-133						(level 4)			
				STS-134						(level 4)			
Space Station Freedom Program										(level 1)			
Uncrewed space flight										(level 1)			
											An Explorer mission managed by the Office of Space Science Mission and Payload Development Division focused on the study of accelerated particles arriving from the Sun, interstellar, and galactic sources.		
				Advanced Composition Explorer Mission						(level 2)			
				Advanced Satellite for Cosmology & Astrop						(level 2)			
				Aquarius Mission						(level 2)			
				Asteroidal Cometary Missions						(level 2)			
				Comet Nucleus Tour Mission						(level 3)			

- Allow for user and Subject Matter Expert participation in the development and maintenance of the semantic system.
- Identifying the components and functions of a semantic system makes development more palatable. Spreadsheets are the most common tools!



# Encourage User Participation

**JSC KNOWLEDGE ONLINE**

Search JK0

Home Case Studies Resources Lessons Learned QMS Lean 6 Sigma Storytelling Voices Taxonomy Who To Call

## JSC Taxonomy Feedback

**STS-133**

Programs & Missions » Space Shuttle Program » Space Shuttle missions » Space Shuttle crewed missions » STS-133

**Description** Discovery's STS-133 flight will deliver install the Permanent Multipurpose Module, the Express Logistics Carrier 4 and provide critical spare components to the International Space Station. This will be the 35th shuttle mission to the station, and Discovery's last flight.

**External Link:** [http://www.nasa.gov/mission\\_pages/shuttle/shuttlemissions/sts133/index.html](http://www.nasa.gov/mission_pages/shuttle/shuttlemissions/sts133/index.html)

**Additional Information**

**Use For**

- Shuttle 133
- Space Shuttle 133
- STS 133

**Feedback (0)**

No feedback exists for this term.

Image of the STS-133 mission patch

**Related Information**

**Carried**

- Multi-purpose logistics modules
- Robonaut 2

**Crewed by**

- Barratt, Michael R.
- Boe, Eric
- Bowen, Stephen G.
- Drew, B. Alvin
- Lindsey, Steven W.
- Stott, Nicole P.

**Has vehicle**

- Discovery

**Launched from**

- Launch Pad 39A

Web Accessibility and Policy Notices | JSC Home  
Responsible NASA Official: [Jean E. Engle](#) | Curator: [Allan Stilwell](#) | Site Administration  
Last Modified: 12/17/2010 | Visits: 265903

➤ Consider this a monitored folksonomy, meaning the product is centrally broadcast, not individually applied.



# What We Have Learned

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- Read the manual
- Examine the rulebases
- Maintain separate, but integrated domains
- Governance is both overarching and local
- Don't *require* SMEs to manipulate the semantic system, but allow user participation
- Spread the word
- Test. Test. Test.



# What We Suggest

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- Plan your semantic system based on end user expectations and how the components of your system will meet them
- Define the scope for each component and personnel working them
- Consider the content to be represented, are there document management procedures in place to serve as a reference?
- Identify the time frame to be included: historical information retrieval, roadmap for the future or both?
- Recognize continuous maintenance and governance needs
- Inform the funders, set realistic expectations



# Conclusion

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At NASA Johnson Space Center (JSC), the Chief Knowledge Officer has been the champion for developing the JSC Taxonomy to capitalize on the accomplishments of yesterday while maintaining the flexibility needed for the evolving information environment of today.

A clear vision and scope for the semantic system is integral to its success. The vision for the JSC Taxonomy is to connect information stovepipes to present a unified view for information and knowledge across the Center, across organizations, and across decades.

Semantic search at JSC means seamless integration of disparate information sets into a single interface. Ever increasing use, interest, and organizational participation mark successful integration and provide the framework for future application.

# Perspective has its Advantages Too!



Tracy Caldwell Dyson  
ISS Expedition 24

